BIO-DYNAMICS

A periodical furthering soil conservation and increased fertility in order to improve nutrition and health.

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SUMMER CONFERENCE

Delayed a day in his return by air from a brief visit to Europe, Dr. E. E. Pfeiffer was greeted with warm and prolonged applause when he addressed the second day's session of the annual B. D. Conference at Spring Valley, N. Y., on July 29th.

Fresh from meetings with agricultural leaders in Europe, and a London conference at which he was the principal speaker, Dr. Pfeiffer plunged directly into the fundamentals of the organic fertilizer problem, outlining both popular misconceptions, and accurate concepts based on scientific observation.

The importance of a clearer differentiation between the terms "organic matter" and "humus," in describing soils, was emphasized. "Organic matter" comprises *all* combustible matter, including humus, but also leaves, roots, half-rotted parts of plants, decaying animal matter, etc., etc.

Humus is only that fraction of organic matter which has become "soil-like" in structure, digested by micro-organisms, earthworms, and the fermentation typical of living soils.

"There is also the acid type of humus," the speaker continued, outlining further divisions, "and the more neutral or colloidal type. After many years of research, the conclusion was reached that the only type able to maintain fertility over a long period of time is the rather neutral, colloidal humus. This humus ranges from the slightly acid (6.2) to the slightly alkaline (7.5). In this range of pH we have the 'healthy' range of soil. Any other humus is outside this range, i.e. it may not be stable.

"The thing is complicated by the fact that humus is not to be expressed in terms of a chemical formula. Rather, it is a state of existence of organic matter mixed with mineral matter in the soil. We should amend that expression and insert the word 'living.' It is a question of *living* existence, because where the humus state is present in a soil, the broken-down organic matter is taken up and digested and transformed by micro-organisms present there.

"Science estimates 400 pounds of earthworms present in an acre of good soil, and studies show that these produce 40,000 pounds of humus a year. Then there are the bacteria, such as the nitrogen-fixing azotobacter and nitrosomonas, the actinomycetes and streptomyces. These are all aerobic bacteria. The result of their action is seen in humus. The anaerobic do not always produce humus, but break down organic matter in a process accompanied by losses of nitrogen, carbon dioxide, etc.

"It is necessary to control the bacteria, because some kinds produce gases and acid substances, and bring about losses of chemical elements in the soil while at the same time no organic matter is built up.

"*The wrong kind of microbial process in the soil can give us as much and more trouble than what we get from the use of the wrong kind of fertilizer.* Thus, with the need for controlling

the microbial process in the soil, we are up against a new phase of agricultural science.

"It must be emphasized that all these bacterial processes are well-known, and were described long ago. Bacteriology developed more and more toward pathology, making splendid contributions in that direction, but side-tracked the development of knowledge of what makes a healthy soil. Typical of this is the discovery of streptomycin and its uses while the soil-building properties of the streptomyces are a lot less well-known.

"Even among the large group of pneumococci, some harmless nitrogen-fixing species can be found in soil.

"The amounts of humus-forming bacteria in good soil, and in compost, are marvelous. There are up to 1,500 pounds of bacteria per acre in a good soil and in addition 750 pounds of fungi and 750 pounds of 'good' nematodes.

"About 25 to 30 tons of humus per acre are produced in good soils each year by micro-organisms. So *our* 10 tons of manure per acre are really only a fraction of what is produced by the soil itself. Compost and manure serve only as a *stimulus* to building the soil. With compost and manure we could never produce sufficient organic matter per acre to maintain fertility. Some organic farmers have learned this through bitter lessons. They started, for example, with the idea that 5 tons per acre of manure was enough for their orchard; or they put on 10-12 tons of manure for field crops but at the same time did not maintain proper conditions of aeration, through cultivation and management, in order to maintain their soil life. They were then disappointed when the results did not match the efforts.

"*Only if the proper process of soil life is present is it possible to maintain soil in a fertile state.*

"If a soil is mineralized, it is important to remember that we do not only need to replace the organic deficiencies, but we need somehow to restore a *soil structure* in which the soil can maintain itself. That is, if we do not have proper living conditions for the soil population, we cannot maintain fertility even by means of organic fertilizing. Such necessary conditions depend on proper tillage of the soil and proper crop rotations. Otherwise it is impossible to maintain the soil life, whether with organic or with chemical fertilizing.

"In breaking down organic matter into compost, we have to introduce a twofold microbial process: first, one which breaks down the organic matter; and second, a process which transforms this broken-down matter into humus. And to be useful, this humus, be it recalled, must be within a definite range of pH, and saturated with microbial life.

"An acid type of humus, resulting from a break-down process that was too acid, usually ends with carbohydrates or cellulose breaking down into carbon dioxide, which disappears as a gas into the air, and with proteins losing their nitrogen as ammonia. In water-logged soils such processes may take place with organic matter in the field itself. If there is not enough drainage, or if

there is a hardpan underneath, an acid humus will be produced. This humus can be easily washed out. And if the soil happens also to contain iron, and the farmer uses some chemical fertilizer in addition to organic matter, there often are deposits of iron-calcium products (bog-iron), that are hostile to root growth. If the farmer finds these podsole deposits, usually of a rusty, brownish color, he is out of luck. He had better give up, unless he has a chance to do a thorough job of subsoiling.

"Reforestation is generally recommended for such soils. But reforestation will not help. I have seen too often, that when the tree roots hit such layers, after 25-30 years of growth, the trees die off. I just saw an example of this a few weeks ago in the South of England, near Dorchester. A whole grove of 20-year-old trees has just started to die because the tree roots are encountering a podsole caused by agricultural practices of the sixties to eighties of the last Century.

"A knowledge of all these processes is absolutely necessary for the maintenance of humus in the soils, and for composting. I mention all this, not to advertise any composting process, but to bring more knowledge of these matters to our friends. *These things are generally not taken seriously enough.* For example, if we induce the wrong kind of fermentation in making compost, we do a lot of harm. If we are making a compost that is acid, its effect can be to produce acid deposits and podsole layers in the soil.

"Soil conservationists ought to think not only of horizontal or mechanical erosion but also of organic losses resulting from a disturbance of the organic structure.

"In breaking down organic matter, we deal with two types: one is woody or strawy, with a lot of cellulose and lignin; the other is material mainly of animal origin, with a lot of nitrogen and proteins. One principle to remember with regard to either compost or manure piles is that if they stink, it is a sign that they are going through the wrong kind of fermentation. Proper fermentation takes place only within a small range of conditions. It is important to see that carbon- and nitrogen-containing materials are present in proper proportion. The literature says there should be 11 parts of carbon to 1 of nitrogen. I think we can enlarge this, and the result will still be good if we have 1 nitrogen to 20 carbon. If we have 1 nitrogen to 6 carbon, we get an evil-smelling fermentation, as in feces. In straw, on the other hand, there are 44 parts of carbon to 1 of nitrogen. It is important that the nitrogen proportion be properly cared for by the fermentation process and by the mixture of ingredients in setting up a heap.

"In this connection it should be noted that it is a bitter fact, but a fact just the same, that *nitrogen-fixing bacteria will not function in mediums where nitrogen has been added artificially.* That is, when we add a mineral nitrogen source, the nitrogen bacteria get lazy. They eat up what we provide, but will not fix nitrogen. Every bacteriologist knows this.

"The farmer is frequently told to apply nitrogen fertilizer to legumes which would produce more nitrogen by fixation than he ever can buy. It seems to me, that the facts indicate that the nitrogen problem has to be solved along organic lines if it is to be solved at all.

"Any particular compost *might* be a good one. And it might be poor, in which case you can apply ten tons per acre and get no result. We have figures, checked and re-checked, from the analysis of dozens of composts in terms of nitrogen, calcium, phosphorus, trace minerals and the bacterial content. It is a sad story: many composts and commercial organic products are very low in nitrogen. Such an experience reveals one thing: they are not made right. They include broken-down organic matter, but *not* humus. When such products go into the soil, they still need to be transformed into humus.

"Fertilizer science now concedes the need of organic matter in the soil. The thought also is just to plow under organic matter, whether green manure or something like sawdust or shredded straw. One can do it, but one will frequently get broken-down organic matter that will eventually be lost. It will not contribute to the 'holding' capacity of a soil.

"Not all composts are really humus. Many are just broken-down organic matter. These need to go through a further process in the soil. They will do so if the particular soil is properly tilled. But if it has not been properly tilled, or if there is a drought, or too much rain after the ploughing-under, the process of humus formation will not take place.

"A good word for this capacity of a soil is tilth. Good tilth means that a soil has proper living conditions for the micro-organisms and is able to produce and maintain a stable humus.

"Many of these 'incomplete' composts, we have seen, do not, themselves, produce good tilth. Sewage sludge or fresh manure still have many intestinal bacteria, etc., and their fermentation process does not end in the formation of humus. I have to mention these things because organics, and particularly our Bio-Dynamics, are close to my heart. We can get results in no other way than by paying attention to such facts. We should not bring our personal 'fancy' or 'hobby' into our organics, but should bring science into it. Otherwise there will be a back-firing."

Dr. Pfeiffer went on to say that the best results of "tilth" he had ever observed had been viewed by him 10 days previously on some farms in the Netherlands, which he had managed from 1926 to 1938. The second farm, on the island of Walcheren, had been under sea water for 14 months after the farmers had agreed to having the dykes bombed by the English in order to drive the Nazis out (in 1945).

When these soils were again drained, they were spongy, the humus was destroyed. They were full of salt, but had no structure. A year after the water had been drained off, it was found that certain weeds would grow on the soil of this farm. And

these were some of the "weeds" used in the B. D. preparations: chamomile, stinging nettle, yarrow. The Dutch Government demanded a heavy application of gypsum (calcium sulphate) to harden the soil.

"We were not able to avoid the gypsum," Dr. Pfeiffer went on to say, "but the astonishing fact is that these farms have recovered after a few years and are back to full production. The B. D. farms on Walcheren are the only ones where trees grow again. Otherwise the island is still depleted of trees and wind protection. Our farmer planted fast-growing fruit trees, and other trees for wind protection. The fruit trees are having their first crop this year.

"Another farm in Holland, not among those flooded, has been B. D. since 1928. It has had 20 years of B. D. treatment, including proper crop rotations and tillage. These various farms show that it *is* possible to maintain fertility, or to restore war damage in 4 to 5 years. Nothing has come true of the prophecies of the fertilizer school, that in the long run—by using organics—the soil will be depleted in regard to minerals. The contrary has come true."

An interesting sidelight was cast on the weed problem. The speaker said that as a farm manager, one may insist on clean fields, while as a bacteriologist one knows that some weeds are actually beneficial.

On the preceding day the sessions had been opened with talks by members and friends and a conducted tour of the Threefold Farm, with its dairy herd and little Grade A Raw bottling plant. Ernest Daniel took the visitors around, and many sampled the milk. F. Heckel was among those who spoke in the morning.

The first evening of the conference, Miss Evelyn Speiden of Chester, N. Y., secretary-treasurer of the Bio-Dynamic Farming and Gardening Association, Inc., conducted a "garden clinic."

A large part of this round table discussion concerned itself with mulching and its advantages for the garden. Miss Speiden pointed out that mulches do not only help against drying out in hot, rainless weather, but also against the obvious dangers of erosion in a wet time and the less considered splashing effect of raindrops. This latter gives us the "crusty" soil that appears in gardens after a spell of wet weather.

Salt hay rather than old meadow hay was recommended by those participating in the discussion, as the latter brings many weed seeds and grass seeds into the garden area. Miss Speiden said that the most ideal mulch was half-rotted B. D. compost, which would have a mulching effect and at the same time finish its decomposition around the plants. Such use of B. D. compost is not to be confused with the practice (wasteful of plant nutriments) of spreading raw compost material right on the garden area.

Alice Heckel spoke on *the earthworm*, bringing together the observations of various authorities from Charles Darwin to

Dr. Oliver. She told of how one can breed one's own earthworms, citing for example the mixture of materials that goes into the Bronx Zoo's earthworm pits (where they are bred to feed the duckbill platypuses). And she said that the B. D. experience had been that if we have a good soil such as we can get through proper fertilizing practices, the earthworms will migrate into it and we will have an adequate earthworm population.

On Saturday afternoon there was a demonstration, by Dr. Pfeiffer and Mr. Peter Escher, of the new composting technique for the large-scale utilization of municipal and industrial garbage. This method, making use of fine mechanical grinding along with Dr. Pfeiffer's B.D. Compost Starter, has been described in some detail in previous issues of *Bio-Dynamics*. The visitors at this conference inspected compost, ready for field use, which had been organic waste 5 days before, and they watched the running of the Mitts and Merrill Red Band Hog, as new material was ground, mixed with the starter and blown out onto a pile.

Later that same afternoon, Miss Speiden gave an interesting talk on herb teas for beverage purposes. She emphasized that she was not qualified to discuss any medicinal values, but was interested in the many possibilities of herbs as beverages, for those who wanted to get away from tea and coffee. She suggested switching frequently from one herb to another, "so that one would not find them also, habit forming".

On Sunday, Dr. Pfeiffer developed further some of the themes of his first lecture. He presented figures which showed that the organic fertilizer needs of a Southern soil were in general greater than the amount of organic material available even with the keeping of livestock. This is based on the quick disintegration of organic fertilizer in climates like those of Southern Texas and Southern California. Hence such places will be in particular need of cover crops, inter-cropping and the use of soil-protecting crop rotations. Which, he added, means that organic management can only be considered in connection with crop rotation and tillage practices, not as a matter of fertilizer alone. And this is basically true in any climate.

Green manuring (the plowing in of green matter to build up a soil), is a practice that has been enthusiastically advocated by representatives of the organic idea. It brings great results, said the speaker, and, on occasion, also great disappointments.

"If we plow in a green crop on a heavy wet soil, and then follow it with a potato or root crop, this will probably be a failure", Dr. Pfeiffer stated. "This is because potatoes or root crops do not like half-digested organic matter. Also, a heavy soil is not suitable for green manuring. Green manuring on a light soil is a good thing, but in heavy clay soils I have found masses of undecomposed green material after two years.

"Plant roots will not go through these matted masses, the crop comes to a standstill, and then falls a prey to insect pests. Yet—and I do *not* mean this as a critical remark, but rather as a necessary observation—our organic enthusiasts frequently

read somewhere of a new idea and get excited about it and then advocate practices they have not tried. Or they may have tried them just once and not followed the matter up for 4 or 5 years to see possible damages from the practice. And the result is that many a farmer gets bad results from trying an untested practice.

"I feel entitled to say these things, because I have not learned organics at a desk, but by trying it out myself. It has cost a lot of money, to develop the Bio-Dynamic Methods, from indications given by Rudolf Steiner, to a matter of agricultural practice.

"In propagating any methods, presenting them to others, we are responsible not to tell people of a 'beautiful ideal', but to give them material in practical terms, so that they can make a living by means of it. The use of organics needs as much experience and knowledge as does farming by other methods; unless we have done something ourselves, we really have no right to tell it to others.

"Thus, for instance, while it is true that on an established organic place the insect pests and plant diseases definitely do not spread out and do much damage, it is *not true* to say that you will have no pests or diseases on an organic farm."

Facts as to the chemistry of animal manures were outlined in some detail in a later lecture by Dr. Pfeiffer. Data on various commercial compost preparations, listed as Product A, B, C, etc., were also given.

On the final day of the meeting, there was a field trip in the course of which a visit was paid to the charming homestead project of Mr. and Mrs. Nemett at Chester, N. Y. In this organic establishment there are fine vegetable gardens, and equal attention is paid to flowers and shrubbery. Goats, rabbits and chickens provide manure, which receives full B.D. treatment before being applied to the soil.

The major part of the day was a tour of Dr. Pfeiffer's own dairy farm at Chester, N. Y., where all the principles enunciated in the preceding sessions could be observed in practical use. Dr. Pfeiffer took the visitors around the place and answered their questions. Much time was spent with the herd of Holstein cows, whose average milk production has gone up from 7,500 pounds per year in 1944 to a figure of about 9,500 pounds a year today. Along with this there has been the disappearance of Bangs disease (brucellosis), so that for the past 3 years it ranks as a certified herd. Dr. Pfeiffer gave full credit for the herd improvement to Mrs. Pfeiffer, under whose active management it is, and to her helpers.

A great deal of ground was covered in the few hours at this farm, with the conference participants viewing a variety of items, from Dr. Pfeiffer's own simple and time-saving bookkeeping methods to a beautiful field of Krug's Yellow Dent, an open-pollinated corn grown from organically produced seed from

the Halbleib Orchards—a corn described in some detail in an earlier number of this quarterly.

The later harvest of this corn on the Pfeiffer farm exceeded any previous experience. It grew 10-12 feet high, and yielded about 15 tons of silage per acre. F. H.

IMPRESSIONS OF AGRICULTURE ABROAD — 1950

EHRENFRIED PFEIFFER

The eye which is used to seeing abandoned farms and vacant lots overgrown with weeds, hillsides and pastures burned by summer heat and drought, erosion symptoms or even healed erosion scars, is enchanted when it rests on the lush, green meadows, fields and woods of Switzerland. Every little spot of land is cultivated, small gardens for vegetables can be seen near every house and around every village. These are all well organized as to crop rotation, clean of weeds, the plants were all strong and sturdy, the potatoes excellent (the writer's visit began at the end of a period of good rainfall at the end of June); in short, growth was abundant everywhere. Remembering the struggles we had here with drought in 1949 and the excessive rains of this last season, Switzerland's nature seems to be extremely kind to her farmers and gardeners. Several farms were visited and old acquaintances and friendships renewed after a lapse of 10 years.

The whole country looked like yesterday, as though nothing had changed. On the whole trip through Western Europe no other impression equaled the strength of the one that in Switzerland other times are preserved. The country as a whole is clean, beautiful, with flowering gardens everywhere; there is no speck of dirt or litter in the streets, the people are friendly.

The crop rotation in agricultural areas seemed a bit top-heavy in potatoes and grains; still a result of the war food economy which was instituted to provide the Swiss with enough carbohydrates in their isolation amid the surrounding fighting nations. The program of this war economy plan seemed to have been a success. One result of this self-supporting food supply program has been that very few pastures were kept since all available land had to be used for crops (including hay). Except for the Alpine meadow management areas hardly any livestock was outdoors on pasture during my visit. It was the tendency of the farmer, for lack of land, even before the war, to feed his livestock in the barn during the summer too, with green grass and legumes which were cut every day. This tendency has now developed to the extreme. In spite of the "good looks" of the fields the writer could not suppress a foreboding that the production scheme, pitched to high yields in every possible way, neglecting the natural balance which is brought about by a pasture system, must backfire somewhere.

The first inkling came when in a newspaper report of a meeting of the Swiss Representatives (Bundesratssitzung) it was stated that for the first time since the war the tuberculosis rate of livestock had dropped below 50%, yes 50%! The newspapers also warned people not to drink any unboiled milk, because of contamination. Sanitary milk production is not generally practiced as yet in the land of shepherds and farmers.

In discussion with quite a few farmers this problem was further investigated. The troubles with livestock, tuberculosis,

sterility, a certain amount of abortion comprise THE worry of the Swiss farmer. To the writer this seems to be the direct result of a philosophy which tells the farmer high production, high production using all possible means of fertilizer and cultivation but at the expense of health. It is in particular the need for foodstuffs during wartime which necessitated such an emergency production of grain and potatoes which at least enable the people to "fill" their stomachs. In the years prior to 1940 the writer frequently lectured to and consulted with Swiss farmers and always warned them against disrupting the natural balance of crop rotation, arable and pasture land ratio, and tried to get farmers interested in the proper treatment of manure, since applying fresh, unrotted manure simply means spreading out disease germs. Those few farmers in Switzerland who followed the good principles of the Bio-Dynamic method, are not troubled with livestock diseases. They were also able to weather the storm of the Foot and Mouth Disease epidemic of 1937 to 1939. They also produced all the grain and potatoes which were needed for the war economy; they produced just as well as the other farms which were so highly geared.

It was quite an experience to find in the healthiest looking landscape the most poorly kept, diseased animals. The question was raised as to how long this state of affairs has existed since testing for TB had only recently been introduced and the damage thus revealed. Not all reactors, of course, are suffering from an active tuberculosis, nevertheless, according to standards of health in the U.S.A. we would not be able to sell milk or even keep cattle under such circumstances. (I didn't dare to tell my Swiss farmer friends that in 10 years of farming and advising in this country I had never seen a TB reactor.) I would not emphasize this situation so much were it not for the fact that official representatives of so-called scientific farming in Switzerland ridiculed the Bio-Dynamic Method before the war, to such an extent that many a farmer who felt that he was going in the wrong direction did not dare to change over to organic principles for fear of the pressure of public opinion. If today the Swiss war economy of the land is highly appraised in such circles as the Food Council of the U.N., one ought to know too that the health problem has not been solved. It should be a warning that high production alone does not solve the needs of a country, but that the health of the livestock and the people is as important or more important than mere tonnage or gallons of production.

The handicap of the Swiss farmer is twofold—and this may be brought forward in his favor. In the first place there is not enough land. The methods used by the farmer in the physical management of the land compared with the highly mechanized and rationalized methods in the U.S. seem primitive but are justified through tradition and the fact that the individual farm is much too small to permit the purchase of modern machinery, tractor, combine, all crop harvester, milking machine, etc. Many a farmer has to make a living as a dairy farmer with 6 cows

and/or 16, 30, or 40 acres of land. He must be admired for being able to do so. A 60 to 100 acre farm is already a large one. Only a few really large farms exist, large enough to warrant the equipment which is usual on every 150 to 200 acre farm in this country. Three times as many men are employed on a proportionate acreage there than we could afford here.

The inheritance system has done the greatest damage in regard to the land. Once a farm was large enough to be economical. Then 4 sons inherited the land and four farms were made out of one. Then these farms were again split into smaller and smaller units. In many cases individual fields were divided and now a farmer may own ½ acre here, another 1/3 acre a mile away, a third piece in an entirely different direction. All this necessitates much idle traveling and does not allow the efficient use of machinery. Then too, machines are twice as expensive as they are in the U. S. To sum up, the farmer as an individual is to be excused. He is fighting a brave fight for survival. It is beyond his reach or authority to bring about a change in the social conditions under which he has to live. His best intentions are frozen by the system. Unless there is a general pooling together of the land and new distribution of it in workable and economic units no improvement can be foreseen. The overhead is entirely too great. Only great economic revolutions can help there.

There is, however, another matter involved here which I would like to present to the manufacturers of agricultural machinery both here and abroad. The recent trend in farm machines is towards larger and larger units. This cuts out the small farmer entirely, for he has neither the capital nor a big enough farm to make large machines practicable and economical. Custom work or sharing in machines does not always work out, especially for field work and haying where timing in accordance with the weather is essential. There is a great need for machinery on a smaller scale, practicable and cheap enough for the small farmers all over the world.

A bio-dynamic conference was held in Dornach near Basle, Switzerland on June 24th and 25th. Peasants and gardeners from all over Switzerland, from the Black Forest and Alsace gathered together and exchanged experiences. The meeting was attended by well over 200 people. The writer reported on the work in the U.S.A. and the recent discoveries and practices of the bio-dynamic method as well as on the findings of the Biochemical Research Laboratory. Many visitors showed up during this meeting who had had no opportunity to come for the last 10 years. Problems of humus, composting, livestock health, human health, insecticides, etc. were discussed, problems of very much the same nature as those discussed at our bio-dynamic conferences over here. The senior forester of the City of Basle reported an interesting detail, namely that poplars completely consumed sewage sludge and transformed it into good humus on a meadow into which the sludge had overflown.

The experimental garden and greenhouses, under the faithful guidance of Erica Riese, of Biochemical Research Laboratory at the Goetheanum, showed impressive results in plant breeding, particularly of a new type of wheat which had been developed according to suggestions of Rudolf Steiner. During the years from 1926 to 1940 the writer with Erica Riese, Martha Kunzel (in Loverendale) and others, E. Voegele in Germany, developed new forms of wheat from spelt and other related plants. The experimental garden in Dornach is a model of what can be done in this regard. New transmutations are still produced every year. The biochemical research laboratory itself, which Dr. Pfeiffer left behind when moving to the United States, has continued to develop and to work with the diagnostic crystallization method under the leadership of Frau Dr. Frida Bessenich. Since it has been made possible to preserve blood so that it can be shipped from great distances, numerous samples are received from all over Europe and quite a few crystallization laboratories have been set up in France, Germany and Finland recently. In Germany the work of Dr. Alla Selawry and Hans Krueger of the Weleda in Schwaebisch Gmuend, merits special mention here. (This work will be presented to our readers at another time, once the complete story can be told.) Another interesting line of research in the Dornach laboratories is being done by Joachim Schultz with rhythms and cycles in connection with plant growth. It is hoped that *Bio-Dynamics* can bring out original publications on this subject too in the near future.

On the trip from Paris to Switzerland an unusual amount of lodging wheat and oats was observed, due to excessive nitrogen fertilizing. None of these fields could have been harvested with a combine or even with a reaper and binder; the grain was almost flat to the ground in many places. One could not help thinking: What is the use of forcing to too high a production under such circumstances?

Another highlight of the trip was the visit to Holland. This country has made a remarkable recovery from the damages of war. This writer was particularly interested to see the Island of Walcheren. From 1926 to 1938 he had been building up and directing the N. V. Loverendale, an organization which, before the war, owned two farms on the Island of Walcheren, one near Duiteloord in North Brabant, all together more than 500 acres well equipped and with a high grade stock of Holstein cattle for breeding and milk production. In addition there were 21 acres of truck garden, 2½ acres under glass, a bakery which produced over 7,000 loaves of bread a week and a food processing plant. Loverendale had a prospering retail sales organization all over Holland for all of its products. The Bio-Dynamic method was introduced there as early as 1928. After the writer left for America in 1939 Dr. H. Heinze further developed the company. All the work which had been built up there came to a complete standstill during the war and with the inundation of Holland the two farms on Walcheren, the bakery, the truck garden and green-

houses came to an end, or so it seemed. The land was flooded with salt water for 14 months, as a result of the struggle of the brave Dutch people for freedom.

Before the war Walcheren was a beautiful place with groups and avenues of trees and lush crops. In the flooded area not a single tree or plant survived. The truck garden and greenhouses, once the producers of healthy crops grown with the bio-dynamic method, healthy without sprays, treated only with bio-dynamic compost and manure, were completely destroyed. The manager of the truck garden, Heer Steyn and his brave wife tried to rescue whatever was possible. Today, when visited in July 1950 the land had completely recovered and the crops stood there as beautiful as ever. Skillful soil management, taking care not to disturb the soil structure, had brought about complete recovery. The damage to buildings had been repaired, new dairy herds are in the process of being developed (with government subsidy) and new drainage ditches are being made to take away the salt water and get the land dry. The Dutch people in general are the masters of good drainage and the reclamation of land and have again proven their ability in the stream of history.

Heer Steyn had taken over one of the farms, since the truck garden was irreparably destroyed, and started to plant poplars and alders for wind protection. Under the shelter of these trees, which have grown to a sizable height in four years, fruit trees were planted, intercrops, cover crops, vegetable crops were started between the small trees; in short, not only a model but a perfect model of bio-dynamic principles has been begun again. Today this farm can be spotted from afar as the only one on Walcheren where trees and windbreaks grow again. This is due to Heer Steyn's initiative and merits the highest commendation. One wonders why other farmers on this badly mauled island do not follow this example? Is it just that commercialism has become so powerful that they are blind to the beneficial effects of biological principles? At one time a collection was even started in this country for trees for Walcheren (not a bio-dynamic one). Nothing has come from it so far. Do the Dutch farmers of Walcheren need further demonstration of the devastating effects of the wind on soil and crops to get wise? One hears there of the farmer who waited two years until the natural weeds grew again and has today the best soil structure on his land while many others struggle with salt crust, and hardpans resulting from "efficient" modern methods.

When Loverendale started to work along bio-dynamic lines in 1928, it was said that a bio-dynamic farm could not keep up in competition with modern fertilizer methods. The moist cool climate, the high ground water level in Holland seemed always to favor applications of commercial mineral fertilizer. Holland as a whole therefore used much more commercial mineral fertilizer than any other country. The crops obtained there with the moist cool climate exceeded anything known in other coun-

tries, especially in semi-arid and arid regions. Today, in the arable agricultural areas of Holland (not permanent pasture) we find, as in Switzerland, dictated by war economy, that the rotations are somewhat top-heavy in grains and potatoes, although some balance is maintained here with legumes. No fertilizer damage seems apparent however, even after prolonged periods of application for the high ground water level has always balanced (or washed out?) the excess. Loverendale as a bio-dynamic farm always had stiff competition to show that one can grow equally large crops without fertilizer. The farm near Duiteloord in North Brabant was our test object. Except for a few applications of 200 lbs. of nitrogen fertilizer per acre after the war, necessitated by the regulations, livestock losses etc., no commercial fertilizer has been used here since 1928. In 1949 this farm cropped 100 bu. of wheat, 75 bu. of beans and oats, 17 tons of sugar beets, all per acre. It is true that other farms in the neighborhood also harvested similar amounts, but at what expense for commercial fertilizer over the same period. The argument that in the long run bio-dynamics will not produce high crops can thus be discredited and removed to the realm where it belongs, among all the other tall tales.

The health of the livestock on the Loverendale farms is up to bio-dynamic standards. On the whole tuberculosis is not so widespread in Dutch cattle as it is in Switzerland, but from information received we gather that there is about 25%. In addition abortion and sterility is widespread. A bio-dynamic farmer would be ashamed to show such a record. Production methods in Holland are much more modern than in any other part of Europe, approaching American standards of mechanization. One practice, that of curing hay on tripods seems old-fashioned to the American visitor who is used to balers and forage cutters. But then there is the fact that all the hay is brought in in good condition in spite of rain and the humid climate, which is not possible at all times with baling. Here an old-fashioned method proves its worth.

Loverendale today, under the able management of P. Clotcher, who learned farming the hard way, beginning in the middle thirties on the bio-dynamic farm in Duiteloord, and through the faithful application of bio-dynamic principles by Heer Steyn has recovered as bio-dynamic center in Holland. The bakery is turning out 700 loaves of whole wheat bread daily. From the ruins of the greenhouses one small greenhouse has been reconstructed, planted with grapes and tomatoes, as healthy as ever without sprays, from transplants and seeds which were also rescued before the flooding. This experience bears out the truth of one of our teachings: that the proper use of the land at all times and under all circumstances, makes it possible to survive all the impacts of war, of economic crisis, of depression. Here are the true sources of the staff of life.

Another center of bio-dynamic activities has developed in Holland near Warmond in the form of a garden school under the

leadership of Mr. and Mrs. K. v.d. Boeke. Around 30 to 50 pupils are gathered together there. The gardens and composts were models of workmanship. The conference there with a youth eager to learn and practice good husbandry and bio-dynamic gardening, was another highlight of the trip, showing that the seed once laid now begins to bear fruit. An agricultural or gardening school of this kind would also serve an urgent need in this country. No method or philosophy is complete even with the best demonstration unless it can be taught, too.

(*A special report on England and Scotland will appear in the next issue.*)

BIO-DYNAMIC SPRAY 508

(AND 507 AS A SPRAY)

EVELYN SPEIDEN

The Equisetum arvense, horsetail or scouring rush, made into tea as 508, is the most used of the three main Bio-Dynamic sprays and also the simplest to make. Our rural grandmothers knew this weed well, using it for scouring pots and pans due to its large proportion of silica, larger than in any other plant. In modern farming areas it is considered a pestiferous weed. Once established in a sandy region, its underground roots are difficult to eradicate. But try to transplant and get it to grow where you wish and you will probably decide it is fragile and illusive. Far easier is it to gather the stuff in its natural haunts.

As Spray 508 it helps the plant overcome fungus diseases and all the various ills so commonly resulting from too much moisture. The warm, wet days that make us feel sticky and uncomfortable, are just the time to think of using 508 in order to prevent trouble, for it is as valuable prophylactically as for the cure of plant disease,—on fruit trees and berry bushes, shrubbery and flower garden, field crops and vegetables. For one thing it seems to stimulate circulation in the outer cells of the plant and so heal quickly a break that would otherwise harbor fungus. It is not a poison but works in a health-giving way.

However, neither 508 nor any other Bio-Dynamic spray will overcome difficulties due to wrong biological conditions in which a plant is placed,—dead and dried out sand, water-logged clay, soil lacking the qualities of good humus or spoiled by being wrongly worked. To get the maximum benefit from any Bio-Dynamic sprays, the soil must first have been helped by compost or manure ripened by the Preparations 502 to 507.

The Equisetum Family is an ancient and distinguished one. In prehistoric times it lived with the dinosaurs, growing to tremendous heights along with the tree ferns. Equisetum arvense is important medicinally and fortunately for us, the most widely distributed of the Equisetums in this country. It is the only member of the family which can be used for 508. An almost microscopic examination is needed to distinguish it from some of the other Equisetums, so consult a botanist friend to make sure of the right plant. The part used for 508 looks much like a seedling pine tree only a few inches high,—taller in a wooded area, shorter and more dense in full sun. The most likely place to find it is on a railroad enbankment. It has no flowers or seeds but grows from spores which are produced on only one part of the plant—the fertile stem. This comes up in early Spring, sectioned like a small and leafless bamboo stalk. Fertile and sterile plants not only look entirely different but grow at different times. Only after the fertile stem has completely disappeared, does the bushy sterile plant appear in early Summer. During late June or early July is a good time to harvest it in New York State. Take only

the bushy, sterile part, not the roots or lower, dirty stems. Gather them in the morning as soon as the dew is gone and spread to dry in a single layer. Artificial drying is not recommended, but a hot barn or attic is a good place provided it is fairly dark and has good air circulation. Never leave them where the sun can reach as this fades the good green color. Properly dried Equisetum arvense should be nearly as green as the fresh. Store away only when thoroughly dry and crisp.

The fresh herb is not good for the 508 tea. It must be dried and it is preferable to gather and dry your own supply where possible.

To make 508 take 3/4 of an ounce (one portion) of the dry herb to one quart of water and boil slowly in a covered vessel for 15 to 20 minutes. Cool, strain and dilute this concentrated tea with a gallon of water, stirring first in one direction until a deep crater forms, then suddenly reversing the direction. Continue this frequent reversal for fifteen minutes of stirring. For spraying, clean equipment must be used—no poison residues—and a very fine mist spray is preferable. With a small garden or only a few plants to be sprayed, less than a portion of the dry weed may be cooked. Tea kept for a few days is likely to mold. It can still be used but is less pleasant to handle, so that to keep the material in dried form is better.

To spray 508 at two week intervals is usually sufficient, but both the frequency and the concentration of the spray are subject to wide variation according to conditions. In prolonged wet weather or with strong fungoid growths, use more often and make each successive application somewhat weaker. The directions above give approximately a 1% solution and this may be gradually diluted to half its strength. The 508 may be used on any kind of plant and for all plant diseases.

Late in the season, but before freezing weather, fruit trees and shrubs benefit by being washed and brushed clean with 508.

The fruit tree paste made with equal parts of clay and fresh pure cow manure liquified with sprays 500 and 508, is also used in Fall on trunks and larger branches of fruit trees after they have been well brushed down to remove loose material, insects, etc. This paste is easily applied with a whitewash brush and should be put on in time to dry thoroughly before it can freeze. This keeps bark smooth, protects it from splitting, hinders the breeding of pests and helps to close up tree wounds. Also it prevents sap from rising too soon and thus avoids harm from early Spring frosts.

The 507 made from the blossoms of Valeriana officinalis is one of the six preparations used in piles of compost or manure. However, it has also been found helpful as a spray for plants, particularly for greenhouse or indoor plants. It seems to overcomes the effects of the glass-filtered light, giving to leaves their normal outdoor variations of green, to flowers a more vivid coloring. During the shorter days of Winter it can be alternated with 508, one each week and with 501 between on every fifth week.

Occasionally spraying of garden plants has been found helpful in getting rid of plant lice.

As a spray, 507 is used in the same proportion as for the compost pile,—one portion (a few drops) in a gallon of water stirred in alternating directions for fifteen minutes. Apply in a fine mist with a scrupulously clean sprayer. Cats are very fond of valeriana officinalis and the 507 spray is attractive to earthworms, providing a potent inducement to keep them confined in boxes where we want them to stay.

All the Bio-Dynamic sprays should be looked upon as refinements of the method to be used in correct order, following the spreading of Bio-Dynamically treated compost or manure. Thus, we gradually learn through our own experience to recognize their effects and to know what can be expected of them, and therein lies the crowning fascination and climax of the Bio-Dynamic method in practice.

QUOTATIONS AND ABSTRACTS

Dr. William A. Albrecht in Nitrogen News and Views, Nov.-Dec. 1949:

"....soil treatments nourishing the plants more completely have earning powers and physiological effects beyond those of mere increase in vegetative bulk. These are especially significant when the crop's higher protein content is better protection against disease and insects along with better nourishment for our animals and ourselves. Nitrogen can pay additional returns in making possible more protein and thereby more protection."

J. H. Boyd and J. O. Dutt in Better Crops with Plant Food, Dec. 1949:

"Every effort should be made to grow legume and non-legume crops in the rotation. They will aid in supplying nitrogen and organic matter to the soil. Organic matter gives the soil a good structure and improves in tilth. It keeps the mineral elements more available to the plants and serves as a storehouse for nitrogen, potash and other elements. Organic matter provides food for beneficial soil bacteria....domestic ryegrass, seeded 20 to 30 lbs./acre just after the last cultivation, in late July or September, develops an intensive root system, which is very important in conditioning the soil and building up organic content. Fall cover crops, such as rye or ryegrass....will utilize the excess nutrients, that would otherwise leach away in many cases....A good growth of rye and ryegrass also will help much to reduce water and wind erosion....All kinds of farm manures make excellent fertilizer materials. Whenever a grower uses any of them he will need less commercial fertilizer. However, all manures are proportionally low in phosphorus and this element needs to be added." (The authors recommend the supplementary use of commercial fertilizers, but do not mention the resources in natural wastes which could be tapped by being transformed into compost.) "In addition to the three major elements, nitrogen, phosphorus, and potash, manure also contains many of the important minor elements which are essential to plant growth. It is also an excellent source of high-grade organic matter which improves soil conditions and greatly influences the availability of all plant food materially. These are some reasons why manure is such an essential factor in soil management for vegetable production."

William A. Albrecht in American Journal of Botany, Vol. 28, No. 5, May 1941:

"The colloidal clay concept, and the clay behavior as it establishes an equilibrium with the plant colloids on the other side of a cell wall has suggested that the humus as a colloidal, organic fraction may be serving similarly as a nutrient ion carrier. This concept has opened fields of study in plant physiology and soil fertility that are bringing the soil and the plant together."

Wm. A. Albrecht. Soil Organic Matter and Ion Availability for Plants. Soil Science. Vol. 51, No. 6, June 1941:

". . . .then organic matter is not only mobilizing the stock of ions constituting its own complex, or even not only those caught by adsorption from solution as they were passing by, but it is also apparently quarrying some cations from rock fragments within the soil to mobilize these also. . . . . .

"If organic matter plays a role in soil development through the mobilization of ions, which may be viewed as a simple chemical process extending over ages of time, and if its role in ion mobilization for plant nutrition in annual cycles suggests that this latter role supports the soil development processes, then, perhaps, other activities of organic matter will gradually add themselves to complete the picture of the organic matter performances in the soil. It may be our misfortune that the understanding and appreciation of the significance of organic matter as a mobilizer of nutrient ions will come too late. By the time we fully appreciate the organic matter heritage in our glacial soils as the source of fertility delivered to our crops at rates commensurate with their seasonal demand for profitable production, then the supply will already be so nearly exhausted as to jeopardize the farming business.

"We need to stimulate further thinking about the organic matter as a mobilizer . . . . organic matter will become a widely used tool for better crop production and for more effective soil and fertility conservation. In the organic matter of the soil is the means of managing the fertility of the soil most wisely for its service to the future."

Prof. Dr. A. Arland in Die Pharmazie, April 1949 (abstract from original paper in German):

The utilization of water through growing crops influences not only the speed of growth, the absorption of mineral substances from the soil but also the yield and optimal utilization of soils. Plants react in a very sensitive way to different types of soil. In very good clay soil the transpiration and loss of water, therefore, is considerably less than in poor sandy soils. The failure of crops on sandy, poor soils must not only be related to deficiencies in mineral nutriments but also to high water losses through transpiration. Reduction of transpiration through adequate measures, including loosening up of the soil, does not hinder but increases the absorption of minerals and makes plants more winter hard. The more favorable the conditions of the soil, the more economic the use of water by growing plants. (The author could have mentioned the beneficial effect of humus (organic matter) in soil with its high water retaining factor, thus protecting plants against excessive transpiration.)

Prof. Dr. A. Arland in Die Deutsche Landwirtschaft, Vol. 6, 1949:

A high transpiration factor increases rust and mildew. Lime harrowed under on sandy clay soils poor in humus increases

the transpiration, while plowing under lime on those soils did less harm than surface dressing. On the contrary, on clay soils the transpiration was reduced with liming. Hardpan on the plow sole increases transpiration while crumbly soils decrease transpiration.

Prof. Dr. E. A. Mitcherlich. Pflanzenphysiologische Bodenkunde (Soil Science as Related to Plant Physiology). Deutsche Akademie der Wissenschafter. Berlin 1948, No. 23.

"In the most varied countries identical samples of soil, covering more than 120 types, originating in the most different regions of the world, were examined, in their phosphorus content according to 24 different methods and in their potassium content by the application of 17 methods. The results of these investigations were discussed in two international conventions. From this comprehensive work it became evident that there was *no* method which gave results accurate enough to enable one to ascertain exactly the amount of fertilizer to be applied to a certain soil. Various analyses of these soils often produced differing results, so that with respect to the highly qualitative results...it was necessary sometimes to take wrong conclusions into account.... But there should be some reason why this international work, carried out on such a large scale, a work which intensively occupied a great number of investigators from 1933 to 1939, produced results more or less of a negative character. The following are some of the reasons given: The laboratory extracting process cannot imitate temperature, natural conditions of the process of dissolving minerals as plants do. The time element plays a role as does the selective extraction through roots. And thus we realize that for plenty of reasons, even using the same solvent as the plant does, i.e. carbonic acid—which during the respiratory process of the roots should be present in sufficient quantities—we *cannot* reach our goal". (Quantitative experimentation with plants is therefore required, that is, let the plants do what the laboratory cannot do.)

Mitcherlich now discusses the law of diminishing returns; if a certain amount of fertilizer doubles the yield, twice that amount only produces 50% more, three times the amount only 75% more. According to data based on more than 40,000 fertilizer tests he found, for instance, that phosphoric acid produced half of the maximum yield at 40 lbs. per acre, potassium 60 lbs. per acre, nitrogen at 200 lbs. per acre. "However, this does not enable us to state how much the yield will increase as the result of a certain application of fertilizer". For plant growth is determined by many growth factors. "Nitrogenous fertilizers dissolve so readily in water that large applications cause plasmolytical phenomena in plants and consequently a decrease in production. Cereal products, for instance, should be given hardly more than 50 lbs. nitrogen/acre or 100 lbs./acre to crops which do not lodge. Fertilizers are preferable which give up their nitrogen only slowly in a form in which it becomes available to the plants

only gradually and during the entire growing period. Such a fertilizer is green manure of legumes, even the culture of legumes,. . .stable manure. . ., especially sheep manure which during the growing period continuously splits off nitrates. These organic nitrogenous fertilizers form the basic application of nitrogen to the soil. . . .In the first place, however, the best possible method for adding nitrogen to our soils by green manure, and generally speaking by treating the soil with stable manure, should be investigated from the standpoint of soil science in its relationship to plant physiology; this is one of the chief problems of our agricultural future.

"The more water a soil is able to retain, to hold and to render available for plants during the entire growing season, the higher will be the yield. However, the water should never become acid, it should be in a neutral condition and should remain so. Acid water and stagnant water, acting as a poison to the roots, should be removed.

"In order to obtain a thoroughly friable condition of the soil, such soil should contain humus, stable manure and green manure or compost for these form a condition sine qua non (a condition without which no results are obtained) for the organisms living in the friable layers of the soil and for that reason the correct handling of humus is a very important question.

"I myself have right now been able to devote exactly fifty years of hard work to this new branch of science. But notwithstanding this, only a weak foundation has been laid for the superstructure which, at a later date, will be erected thereon."

C. L. W. Swanson. Preparation and Use of Composts, Night Soil, Green Manures and Unusual Fertilizing Materials in Japan. Agronomy Journal, Vol. 41., July 1949. (Abstract.)

Before the war, farm manures and commercial fertilizers were equally used to provide for the land in Japan. During the war 86% of all nitrogen, 93% of all phosphate and 96% of all potash came from farm manures. Current domestic production and importation of commercial fertilizers fall short of meeting the needs of Japan. Farm manures therefore are expected to continue as an important factor in the fertilizer program. In 1946 composts supplied 47% of the total nitrogen, 66% of the total phosphoric acid, and 64% of the total potash. Night soil ranks next to compost in the Japanese farm manuring program. It provided (in 1946) 16% of all nitrogen, 8% of all phosphorus, and 10% of all potassium. Green manures supplied 5% nitrogen, 3% phosphorus and 6% potassium. Other organic sources made up the balance, namely plant ashes, seaweed and animal excreta.

Composts were made from grain straw, grasses, seaweed, leaves, lake and stream vegetation. Shallow piles or earthwalled pits are used and are covered against the weather, sometimes with crude straw mats. Night soil, barnyard manure, silkworm excreta are added. Barnyard manure is added in the ratio of about 1:2, silkworm excrement 1:10. The piles are moistened

and compressed by treading on them or leading the livestock over them. Sometimes a layer of soil is spread over the pile. Layers are built up in this way until the pile is 3 feet high. A small amount of lime is added (41 lbs. for 827 lbs. of compost). Fermentation in the cool regions takes from 3 to 6 months, in the hot regions or during summer 1½ to 2 months. Rice straw decomposes faster than wheat or barley straw. The piles are mixed or turned 2 or 3 times and water added if necessary. The applications of compost range from 4.5 tons for rice, barley, wheat and sweet potatoes; 2.2 to 6.7 tons for fruit trees; 4.5 to 11.1 tons for leafy vegetables; 6.7 to 13.4 for root vegetables, melons, cucumbers and tomatoes; 2.2 to 4.5 for potatoes, all per acre. About the same amounts of night soil are used; in some cases a little more, for orchards only 2.2 tons/acre. Night soil has proved to be as effective as sodium nitrate (for wheat), ammonium sulphate (for rice), when equivalent amounts of nitrogen are applied.

Striking increases in the growth of rice were obtained with the application of organic matter from manure composts. Analysis of night soils showed that they differed among different classes of people, according to the food eaten, type of work performed and individual differences in the efficiency of the digestive organs. The night soil from merchants and middle class government officials had a higher content of organic matter, nitrogen and phosphorus than that from farmers, while the potassium content in that from farmers was higher than the other group. Japanese night soil was lower in organic matter, nitrogen and phosphate and higher in potash, chlorine and common salts than in the case of Europeans. Night soil contained 95% water, 3 to 5% organic matter, 1.4 to 1.7% ash. Japanese farmers store night soil in concrete or wooden tanks or barrels, similar to the Chinese method. The tanks are buried in the ground, covered and shaded. Fermentation in summer takes 3 to 4 weeks, in winter 2 to 3 months. Winter night soil is preferably stored until May. Enzymes are added to hasten fermentation, especially of urea. Part of the pathogenic organisms may break down during the fermentation. Vibrio comma (cholera) disappeared in experiments after 1 day in summer, after 15 days in winter; typhoid bacteria in 6-10 days in summer, 125-180 days in winter; amoebic dysentery amoebae 6-7 days in summer, 116 days in winter;hookworm eggs lived 40 days in summer and 111-138 days in winter; round worm eggs survived 40-60 days in summer and 240-270 days in winter. Storing night soil is not an insurance against harmful bacteria, parasites and viruses. Under favorable conditions, certain spores may revive and contaminate crops grown on soil fertilized with night soils.

Some unusual soil amendments are described as red Podzolic soils in cases of "iron-podsolization" of irrigated rice fields, of dried and heated soils, of fish and eel pond cleanings (high in nitrogen), silkworm excreta and pupae, bird guano (2-5% phosphoric acid), and miscellaneous raw minerals.

It was found that the carotene content of alfalfa leaves was highest when cut early in the morning; it declined 5 to 10% until about 10 A. M. after which time it remains constant until evening.

From the Middletown (*N.Y.*) *Times Herald,* August 7, 1950.

More and more cities in the Netherlands are putting a halt to the burning and other types of destruction of city refuse. Instead, large-scale mechanical conversion of the refuse into fertilizer for agriculture is being adopted by most of the large cities.

Extensive tests by the Experimental Agricultural Station at Groningen over a long period have proved that many vegetables and fruits grow faster with natural fertilizer. In the station's experimental orchards, apple trees fertilized with city refuse are now two years ahead in growth as compared with trees treated with artificial fertilizers. In 1949, the crop obtained from the naturally fertilized trees was sixty percent larger than that of the other trees.

As a result, the Netherlands Refuse Transport Company, whose principal plant is at present working to full capacity for the Hague, Groningen and Zandvoort, is establishing new plants in various parts of the country. A new plant at Schiedam will apply a new system whereby the refuse will be ground into fertilizer immediately upon arrival, thus eliminating the necessity of drying the refuse in the fields and mixing it with yeast.

Holland's two largest cities, Amsterdam and Rotterdam, whose huge burning installations are inadequate to meet the demands resulting from growing populations, are both showing great interest in the new revolutionary system of refuse removal. Agricultural and sanitary experts of many European countries are also studying Holland's new system.

Dutch agricultural experts have established the fact that the soil needs natural fertilizer as well as artificial fertilizer and that with the use of artificial fertilizer alone the quality of the soil deteriorates so that each year greater quantities are needed. This is especially the case with the sandy soil in eastern Holland. Organic fertilizer (animal and human) promotes the bacterial development of the soil, whereas artificial fertilizer promotes only chemical fertility.

BOOK REVIEW

BOTANY, An Introduction To Plant Science. By Wilfred W. Robbins and T. Elliot Weier. 462 pp. New York: John Wiley & Sons, Inc. $5.00.

Many of us are apt to shy away from a study of botany because we think it consists almost entirely of learning long Latin names and how to classify plants; that a student of botany is the person who can look at the little plant you show him and say: "Ah yes! This is the Abracadabra spectabilis, note the woolly hairs at the leaf axil, you will not find these in the A. arvense." It is, therefore, a delight to find that Professors Robbins and Weier have not only touched upon the classification of plants (and given good sensible reasons for this branch of botany) but have built up a living picture of botany and its inter-relationship with agriculture, industry, as well as with many of the branches of organic science.

The book is filled with superb photographs, drawings and diagrams which lead one through the intricacies of chromosomes, cell structure, seeds and embryos, fungi, algae, vascular plants, reproduction, Mendel's law, etc. The result is a kind of synthesis, an over-all picture of the plant as it clothes the surface of our planet. We are reminded in the section on bacteria, which are considered as fission plants, that there are not only pathological "microbes" and "germs", but many which perform valuable work in the soil and in association with plants. The "nitrogen cycle" is dealt with at length in this regard. Amongst the fungi we hear of the penicillin producing fungi, also about others which are of value in the making of cheese, as well as in the fermentations connected with brewing and baking.

In a chapter entitled "The Plant as a Living Mechanism" (a rather contradictory combination of terms) all the factors relative to and influencing growth are considered. Here are included the vitamins and trace minerals as well as the factors of water, light, warmth, and the grosser minerals. There is also a vivid description of the activity of different qualities of light and an explanation of the classification of "long-day" and "short-day" plants.

Space does not permit this review to go into all the problems dealt with in the book, however, I would like to mention just one more. The last chapter is a brief but concise summary of evolution in the plant world as it is considered nowadays on the bases of the work of both Darwin and Mendel. The interesting thing though is a final quotation from a man, Dobzhansky, who wrote in the *American Scientist*, "Evolution is a creative response of the living matter to the challenges of the environment. Evolution is due neither to chance nor to design; it is due to a natural creative process." Now here there is a curious confusion of subject and object. Most of us would agree that evolution is not due to chance. Yet if we state that it has no design and speak of a "natural creative process" we imply

that it is a kind of "spontaneous combustion" which springs up in response to the environment. If the plant can be considered as the product of its environment, might we not premise a design of some sort behind the environment? A complex of interacting forces which bring about the response in the living matter.

A. H.

SOME OF THE REASONS FOR US GOING BIO-DYNAMIC

CHARLES W. EDDY

We had our first garden in 1915. From then until 1947 we used the best practices as recommended by our Department of Agriculture—that is, part organic and part chemical. We used a good quantity of NPK fertilizer when we could get it. Some of the years during the wars we could not get the chemical fertilizer so did what seemed the next best thing and used "well-rotted" manure. The years that we used no NPK fertilizer our vegetables were superior in quality, quantity, taste and keeping quality. At the time we attributed this to better weather conditions, more conscientious application of the elbow grease, or any number of other things except the right one. It was only in after years and in retrospect that we realized that our better gardens were because of the leaning toward the organic methods, even as crude as they were practiced by us.

When we first moved to our farm in southern Vermont we sent soil samples to the Vermont State Agricultural College for analysis and recommendations. Their reply was not very encouraging. They indicated that the farm was pretty well run down and that we couldn't do much with it. They suggested that we use 400 pounds of 8-16-16 fertilizer, 1,000 pounds of lime and ten tons of manure per acre. At that time this would have cost us around $100. We had already ordered a half bushel of seed potatoes and 100 pounds of NPK fertilizer for them. This was in 1947 B. D. Or perhaps I should say B. B. D. (before Bio-Dynamics). At about this time we first learned about organic agriculture and the Sir Albert Howard methods. We gave away our potato fertilizer, and did not follow the advice of the State College. We had to get organic matter in a hurry so made a compost heap by combining equal amounts of soil from under the maple trees in the woods, soil from the barnyard and old manure from under the barn. It may be interesting to insert here that some of this manure was standing in water. I checked with the former owners of the farm and decided that the manure under the water had been there undisturbed for about fifteen years; still in consistency, color and odor it was similar to fresh manure. We realized that our compost heap was not all that it should have been.

We also used a little natural pulverized phosphate rock and a little wood ashes. In a few days after putting the pile together we cut the pile down with a spade, taking thin slices off of the end and throwing it into another pile. This mixed it well and in a few more days it was ready for the garden.

We had this first real garden of ours well under way when we learned about Bio-Dynamics. It did not take us long to see the sense of it and adopt it. Perhaps I should say that we let it adopt us. That fall we built a real compost heap. We used cow and horse manure from the old barn, about ten tons of old hay, sod with the soil left on it, from the garden, which had not

been used for a garden for many years and the B-D preparations. This was the year before we heard a talk at the conference on the details of setting up the compost heaps. This heap of ours was about 15' wide at the base and weighed around 30 tons. We realize now that this pile was much too wide for proper intake of air and moisture. The next fall, a whole year later, we made two narrow piles, not over three feet wide at the base.* The following spring the six months standing piles were way ahead of the larger 18 month old pile. The smaller piles had completely changed to humus while the larger one still contained uncomposted hay. The fall, before we had our first Bio-Dynamic garden, we spaded the garden with a spading fork and added the B-D preparation 500. The next spring when we planted we again used the 500 and later, when the vegetables were well up we used the 501.

We have no way of knowing the number of bacteria in the garden but we do know that after using the 500 it was not unusual to find 5 to 10 earthworms on the surface of a spade full of soil that we removed in planting—many more earthworms than we had ever seen in any of our gardens.

After I'd been speaking before a farm organization in Washington, D. C., one of the members came up to me and said, "This organic farming is no good. I tried it out last year and I know. I planted three rows of corn—one with chemical fertilizer, one with organic fertilizer and one without either, and the one row with the chemical fertilizer was by far the best of the three." I said, "How do you judge the value of your corn? Do you have it analyzed for the vitamin, protein and mineral content?" He said, "Listen, I sell my corn by the bushel. I don't care what it contains."

A friend of mine went to see a friend of his. This friend of his took this friend of mine out on his farm and showed him 40 acres of growing potatoes. After looking them over, my friend said to his friend, "How do you grow such wonderful looking potatoes? I never saw anything like them in my life." His friend said to my friend, "Well we start by spreading a ton of NPK fertilizer per acre (he named the formula). Then we use another ton when we plant. As soon as the leaves show their heads above the ground we spray with DDT, lead arsenate, etc, etc, etc." My friend said to his friend, "How do you dare to eat those potatoes?" His friend said to my friend, "We raise these potatoes to sell. If you will come with me up back of the house I shall show you where we raise all of the potatoes and all of the other vegetables that we eat. On these we never use any poisons of any kind, either in fertilizers or sprays."

Last June my daughter and son-in-law graduated from an Eastern University, my son-in-law from the agricultural college.

* These heaps are unusually narrow. Ordinarily 4 feet is recommended as a minimum width for B. D. heaps and 8 feet as an approximate maximum. Less than a 3-foot base width brings a great likelihood of drying out. Probably the northerly climate made these very narrow heaps practical.—Ed.

During his four years of college work there was only once that the subject of organic farming was discussed. Someone asked about organic farming and the teacher said, "I think a 50/50 program is best—part organic and part chemical. This one sentence was the entire education in organic agriculture that the students received in four years of study in agriculture in one of our large universities.

I have talked with scores of people connected with our Government: Experimental Stations, County Agents and the Department of Agriculture. As yet I have never met a person, who is paid by our Government for learning the latest and best about agriculture and telling us about it, who has ever conducted or even observed a single honestly controlled experiment in organic agriculture. Still I have never met one of these people who would not talk against it, either by direct condemnation or by "damning it with faint praise."

GARDEN EXPERIENCES

COLOR AND FLAVOR

RUTH EASTMAN

Early in July the Conservation Caravan came to visit our garden in Up-State New York. During the afternoon there was one comment repeated several times—namely that the flowers in our garden were much more vivid and alive in color than those in other gardens that they had seen. None of our flowers have received any special attention other than the routine B. D. composting and spraying with 500 and 501.

Before the ladies left I cooked a large tureen full of peas, that I had picked a few hours earlier. They all agreed that there was definitely a better flavor than in other peas which they had eaten.

We talked at some length about B.D. methods but I feel that what they experienced through their sight and taste meant a great deal more to them than anything I could say.

TILLAGE AND 500

MARY MITCHELL

The Summer of 1950 in this part of Maryland has been unusually cool and rainy. There have been few hot nights and no humid, oppressive days until August. Our garden has prospered and bloomed and produced quantities of delicious vegetables. The strawberry bed, planted last Summer, instead of bearing scantily was loaded with fruit. I attribute this success to several different factors.

The first one is a secret, unrecognized by most people. On a lovely day in June some of our Washington friends came out for a picnic. While we sat around our yard, some of them had their first experience at stirring 500. When it was ready our Writer and our Artist each took a half of the garden and sprinkled the 500 on. With such help, you see why our garden flourished so finely.

But our neighbors give the credit* to our old colored man who knows when you can and when you can't cultivate our heavy, Maryland clay soil. But this just shows the inter-relation of man and nature in our Bio-Dynamic method. "The proof of the pudding...", this week we are going to have a fine mess of peas, the first of our August planting.

* We think the neighbors are pretty wise country people, and would ourselves give a very big share to the old man. Certainly, the experience of a lot of people indicates that the 500 helped; also—not mentioned above—the good B. D. prepared compost we happen to know the lady used, and the 501 that was sent her—unless, of course, she didn't get around to putting that on.—Ed.

A BIRD'S EYE VIEW OF WORLD CONSERVATION PRACTICES

ALICE HECKEL

We are all more or less familiar with the Soil Conservation Service of the United States and its activities. Most of us are aware of the benefits of forest management as carried on in Western Europe and in England. We have all heard at one time or another of the forty centuries of agriculture in China, yet we know few if any details about it or about practices in primitive, or so-called undeveloped, parts of the world, in Africa, South America, etc.*

It is true, of course, that China suffers from severe floods and inevitable famines in their wake. It is also true that much of this is brought about by their forests having been stripped long since for fuel and building purposes due to population pressures and the cultivation of lands, for this same reason, which should really be kept in cover, both grass and tree. It is calculated that the Yellow River for example, carries away from its watershed every year as much soil as all the rivers of the United States combined. Some of this silt is deposited on the delta of the Yellow River and new land is being gradually built up. However, from estimates, it appears that one hundred hectares (hectare equals 2.471 acres) must be destroyed in the hinterland to build up 1 hectare of this delta land. This is a costly procedure! Indeed, sheet erosion, gullies, sink holes, the formation of shifting sand dunes after flooding by silt laden rivers, all the evils which follow in the train of deforested land and cultivation of soils which should be kept in cover are suffered by the Chinese.

When we consider how rapidly the results of the exploitation of forests, overgrazing of grassland, and the intensive cultivation of cropland without thought of conservation, have spread in the United States in a comparatively short space of time, we wonder how the Chinese have survived. As a matter of fact, compared to the drama of the Dust Bowl of the Thirties, the progress of erosion in China has been a kind of creeping affair. Study of records shows that they have used various methods of soil conservation for centuries. The principles on which these were based are sound ones and really the same principles which govern the scientific, mechanized soil conservation practices on our own continent today. Quotations from ancient descriptions of agriculture in China have a familiar ring, they could be part of the outline of a proposed regional survey to be carried out by a conservation group.

One might put it this way: The first step, the Chinese said, is "to classify land for farming and animal husbandry by studying its suitability". The next step is that to be taken by the individual farmer, his part in the overall program: "A good farmer classifies the soils by studying their differences and selects the right kind of crops to grow so that soil and crops are not

* Source of data: Soil Conservation, An International Study. Food and Agriculture Organization of the United Nations. Washington 1948.

unsuitable and the greatest profit may be obtained from farming". This last might be considered a restatement of the fact that "the biologically correct is economically sound".

Organic fertilizing with compost has been practiced in all parts of China for centuries. Contour farming (not always exactly on contour, yet reasonably effective, just the same), strip cropping, intercropping, and soil conserving rotations, are all matter of course. Corn, for instance, is usually intercropped with soybeans which achieve their maturity after the corn has been harvested. Their rotations always include a legume crop of one sort or another. The value of mulching in areas of low rainfall and strong sun is recognized.

An unusual method of mulching is used on the farms around Lanchow, where the rainfall is barely enough to support crops. The farmers take pebbles mixed with sand from the nearby river beds and spread them on the level and sloping fields in a layer about 3 to 6 inches deep. In this region night and day temperatures vary greatly, and such a mulch helps to work against this wide gap. It also conserves moisture, checks soils erosion and decreases the formation of alkali in the surface soil. This is a difficult and time consuming practice. It is mostly used for crops which yield a high money return, melons, cantaloupes, vegetables and cotton. Such mulches begin to wear out in 20 to 30 years. Then more soil is mixed in with them and small grains are grown. After about 50 to 80 years the mulch must be replaced with a new one, otherwise the soil is usually in worse condition than fields which have not been mulched at all.

Here in the West we have often criticized the peoples of the East for their use of wooden plows with no moldboard, and stressed the lack of efficiency. Recent surveys indicate, however, that this shallow plowing is certainly justified in thin soils and hill country. The natural structure of the soil is not disturbed to any degree and whatever crop residues there are, are kept near the surface, where they help to absorb moisture and increase the organic content of the soil.

In some of the provinces of China one still sees men who are skilled in the laying out of farms for the best production with the least harm to the land. There appear the following phrases on the bags in which they carry their tools: "Leveling the field, strengthening the foundation, digging the pond, and building the reservoir on contract". Such individuals have accomplished a great deal by carrying on the old tried and true practices and by their skill acquired over years of experience.

There are many typical conservation measures which were established hundreds of years ago in China. For instance, the planning and layout current in the Chow Dynasty (1100-256 B.C.) evidently was designed primarily for soil and water conservation. A section of land was divided into nine equal parts; eight of these parts were assigned to eight farm families, the ninth part in the center was cultivated by all eight for the community. A system of furrows and larger ditches was worked out

for each section, which conserved both water and soil. The next dynasty, the Chin Dynasty (255-206 B.C.) abolished this system because they wanted to increase the area cultivated. This must not have worked out very well, because in the Han Dynasty (206 B.C.-A.D. 23) the furrow system was again introduced under a name which means alternate use of the land. Crops were planted in furrows and as they grew the soil was moved from the ridges to cover their roots. By the time the ridges were leveled out the plants were deeply rooted and well established so that they could resist wind and drought. The next year the ridge strips were furrowed and the same process repeated. During a period of seven years drought, about 3000 years ago, a pit or basin system was advised. Crops were grown in pits about 8 inches deep dug in a checker-board over the fields. It is said to have been effective in conserving water and avoiding sheet erosion. It is used very little nowadays; in Kweichow sugar cane is grown on small plots of sloping ground under this system. From a distance such fields look like waffles.

There is a great deal more which could be described and discussed in regard to China and her agricultural problems. However, there are also great tropical areas of the world, about which we know very little. We usually consider such areas, if we think of them at all, as great virgin lands which can be developed and exploited to help feed the rapidly growing world populations. Yet closer study will show this last idea up as a proper "pipe dream", since much of this land is on steep slopes, in parts of the world subject to heavy rainfall, so that once cleared, erosion is swift and dramatic. In tropical and subtropical Asia, Africa and Amercia a type of land use have been carried on for centuries, adapted in each case to the different physical factors. This kind of agriculture is called "shifting cultivation".

In regions where there is a rainy season of four to six months usually there is open woodland in which the primitive tribes practice shifting cultivation. An area of the woodland is cleared, the annual crops desired are planted, harvested, and the next year another area is opened up and the first allowed to go back to the original state.

This is quite all right of course, as long as the population is not too large to be supported by this, and as long as the cattle herds have not increased so much that the adjoining grasslands are not burned over too frequently and cleared areas in the woods are not cultivated for such a long time that the natural cover cannot re-establish itself. These last conditions have come about and have caused great damage. The number of cattle possessed by the primitive nomadic tribe is the sign and symbol of its wealth and standing, so naturally the tendency is to have more and more cattle, even though the individual animal may become weaker and weaker and less valuable.

Various plans have been and are being tried out to remedy these situations, and to help along the natural process of regeneration. Some of these have been based on native practices which

had heretofore been considered unorganized. One of these is the practice of intersowing early and late maturing grains, and of sowing legumes with cereals and root crops. This has been found to stand up in the violent climatic conditions and against insect pests. This practice and others of equal value have been incorporated in a modified plan of shifting cultivation called the "corridor" system. The particular forest tract is divided into corridors arranged so that each cultivated corridor borders on a forest strip. The rotation is based on the fertility of the soil and the thriftiness of the forest, that is, its ability to regenerate itself. A typical example is a six-year rotation of crops followed by a 12 year forest fallow. The brush is burned after cutting, but the logs are left to rot and return organic matter to the soil. A typical mixture of crops suited to this kind of agriculture is : maize, rice, cassava, and bananas. The maize, or corn, is harvested first, then the rice, then the cassava, and the bananas in about 3 years. In between there might be a monoculture of peanuts or sweet potatoes, followed by cassava and bananas or some other shrub crop. This last is put in because this sort of crop fosters the return of the forest. Peanuts, on the contrary, especially in the central Congo, tend to bring in the savannah grasses which delay the return of the forest fallow for about three years.

The corridor system must be applied with care, for it is not possible to use it everywhere. With some crops and in some regions it is better to combine shrubby and tree ground covers with the crops grown as in the case of rubber, cacao, oil palm, and citrus fruits. These are best planted with leguminous ground cover, and in some instances with wild cover. The goal to be achieved is to keep the soil shaded in this way and thus to protect against losses of organic matter and consequently in the fertility of the soil.

Perhaps this brief description of some of the agricultural practices of tropical and subtropical regions and of China may give us a picture of the great variety of practices necessary in view of the soil types, topography and great climatic fluctuations. We shall certainly be reluctant to be dogmatic under such circumstances. It surely can never be stated that what works in Tennessee will surely work in Africa, Burma, India, or China; there are too many variable factors in a purely physical sense. Then too, besides these there are other variables of tradition, social structure and economic arrangements, and that most changeable and chameleon-like of all factors the human being itself.

BASIC PRINCIPLES DON'T CHANGE

A while back, our good friend R. L. Kirby of Blanchester, Ohio, found an interesting old book in a rural library there. He sent it on to Miss Speiden to read, and she copied out some fascinating excerpts. We think they are worth passing along to readers of Bio-Dynamics.

* * *

Success in Farming

Waldo F. Brown

A series of practical talks with farmers written over 70 years ago in Ohio

To make a home for the family where they may be happy and contented; to rear the children to industry and yet teach them that mind and soul, not dollars and cents, give worth to man, and so to manage the farm that it shall supply all their wants constitutes "success in farming".

I do not mean that a farm is never, under any circumstances, justified in going into debt, but what I do say is that a farmer who can pay for a farm of one hundred acres and have money enough left to stock and operate it, is unwise to purchase a two hundred acre farm and have for years a debt hanging over him.

More farmers today are being made dissatisfied with their calling, and hindered in their efforts at advancement by the burden of debt, than by all other causes combined.

There is nothing so essential on the farm as brains and good judgment, and the farmer may cultivate and develop these as well as corn or wheat.

Another very important thing in farm management is to determine how much of the land to plow. There are localities where the plow is the worst enemy of the farmer. By this I mean that many farmers keep themselves and their lands poor by excessive cropping. The farmer should keep ever before him the fact that it is bushels not acres that give the profit.

What advantage is there in underdraining?

It prevents the drowning out of crops in wet seasons.
It enables the farmer to work the soil earlier in the spring and sooner after rains.
It prevents the *souring* of the soil caused by excessive moisture.
It lessens the risk of freezing out in winter grain.
It lessens the risk of surface washing.
It keeps the ground moist and the crops growing in a dry season.
It makes the ground warmer.
It permits a more thorough pulverization of the soil.
It increases the fertility of the soil.

For some years past there has been a gradual change for the better in our system of farming. Farmers are beginning to

ask earnestly: "How can we maintain or increase the fertility of our lands?" and many old fields have been brought back to a yield which equals that of the days of their virgin fertility. I think there are farmers who honestly believe that the legitimate and inevitable result of farming is to exhaust the soil, and that a farm, like a piece of machinery, will wear out and become worthless. The problem we are called on to solve is to restore fertility to lands already impoverished, and to so manage our farms as to maintain or increase their productiveness.

Manure tramped down in the stable or barn yard is impervious to air, and fermentation is suspended, and when we wish to prepare it for use, we fork it up, so as to admit the air and start fermentation.

During many years' experience as a gardener, I have had occasion to test this matter of thoroughly decomposing and fining manure, and I believe a load of good stable manure, so finely pulverized that is could be sifted, applied to half an acre, would produce a heavier growth, particularly of small grain or grass, than four loads of equally good manure spread on it as ordinarily applied.

After considerable observation and experiment with manure, I have come to the conclusion that I get a better return from it when applied at the surface.

There is little difficulty in bringing run-down land to a high state of productiveness if we can get clover to grow in it, and a light dressing of manure at the surface makes a capital seed bed for the clover.

I recollect a remarkable yield of corn from clover manuring about 1861. I owned a field of cold clay land on which I found it difficult to grow paying crops. Corn rarely made over 25 bushels to the acre; but one year when wheat was nearly a failure I had a splendid growth of clover. I did not pasture it in the fall or the following spring and by the first week in May it was six inches high. I turned it under and had fifty bushels of excellent corn to the acre, which, knowing the quality of the land, was a surprise to me. As I think over my experience with clover as a fertilizer, I can say I have never been disappointed with it. Some fail to get much benefit from it because they pasture it the first season while it is young and tender, or turn on it in spring and feed it off so short that it never makes growth enough to shade the soil or develop its roots properly.

Buckwheat makes an excellent rapid growth, and has an excellent effect in pulverizing stubborn soils. It has been claimed by experimenters and scientific men that buckwheat when plowed under, destroys insects in the soil. This is a matter worthy of consideration and careful experiment.

The benefit from green manures seems to be more than the actual plant food they furnish, for their mechanical effect opens the soil to atmospheric influences, and in some way which I cannot explain, the simple shading of the soil enriches it. Harlan

tells of an English farmer who, leaving a door lying on a fallow field for several months, found that for several years the crops were heavier on that spot, as though some rich manure had been applied.

Commercial manures are not intended to take the place of stable manure, but rather to supplement it; and the farmer should save and apply all the home-produced manures before spending money for others.

Capillary attraction...is the power that porous bodies have of not only absorbing but of drawing up liquids. It is the principle that causes the oil to rise in the wick of a lamp. The power of porous bodies to thus elevate liquids is exactly in proportion to the fineness of the pores...A porous soil possesses this power of capillary attraction and hence can, during a dry season, draw up water from the moist subsoil below...and its power to thus draw up moisture will be in exact proportion to the number and fineness of the pores it contains...The more thoroughly the soil is pulverized, the more pores there will be.

Consider...the subsoil. In this, decomposition is slowly but surely progressing and plant food is being set free in an available form; the moisture of the subsoil is constantly charged with useful salts. If we can but draw these up within the reach of the crops, we shall again increase the supply of food in the surface soil. Through pulverization of the soil, by bringing into play the principle of capillary attraction, will draw up this moisture.

Chemical decompositions are constantly taking place in the soil by reason of which material that has previously been valueless is made available as plant food. The more finely the soil is pulverized, the more rapidly and thoroughly will these changes take place.

We find then, that "tillage is manure" because;

Finely pulverized soil absorbs valuable elements of fertility from the atmosphere;

Because it draws up fertilizing material from the subsoil below; and

Because it makes available material already existing in the soil.

I doubt whether the young farmers of today appreciate what progress has been made in agricultural implements. They of course understand how perfect and well adapted to the work are the numberless inventions which make the term "farm drudgery" almost a thing of the past; but they can scarcely realize that only a generation ago it was common for a large farm to be managed with so few implements that twenty-five dollars would be an extravagant price for the lot. Good crops were grown on the virgin soil when a shovel plow and clumsy iron tooth harrow were the only implements used, if we except a ponderous hoe made by the blacksmith.

Be sure you need an implement before you buy it.

There is a fine field for cooperation in the ownership or use of agricultural machinery.

A practical point on which many farmers fail is the care of tools. If expensive implements are left exposed to the weather, the loss and deterioration from this cause will be much greater than from use.

Not only is machine grease cheaper than "elbow grease" but a machine will wear more in a day's work when needing oil, than in a week if properly lubricated. Use the best oil:—for most machinery, buggy and wagon spindles, castor oil is the cheapest and best. Do not buy this of your druggist at 50 cents a pint, a second grade...wholesale at from 50 to 80 cents a gallon is as good.

An occasional going over a machine with a wrench, tightening all nuts, will add greatly to its longevity. Whenever a piece of machinery begins to rattle, destructive wear is going on with great rapidity. As a rule the more silently any piece of machinery works, the better it is doing. (This rule is applicable to men as to machinery—adds the Publisher).

The man who would have success in farming should take as much pride in the condition of his implements as in the condition of his stock.

An important thing in preparing the seed bed is to roll as soon as plowed...If a good roller follows the plow each half day, the land can be pulverized and packed down as long as there is moisture enough to plow. If it is allowed to dry after plowing and before rolling, it is often weeks before there is rain enough so that it can be put in good condition; but if rolled at once, a light rain will make it fit for seeding...I have gone over a wheat field with harrow, roller and plank drag as many as seven times between plowing and seeding time, and have been well paid for my labor.

When the season is such that you must plow late and sow immediately, I would always recommend shallow plowing, for the land will not have time to settle so as to make a solid seed bed, and you will not be as likely to pulverize eight inches well as you will four.

I advise every farmer to keep a debit and credit account with each wheat field.

I have no hesitation in saying that if farmers took as good care of their wheat straw as they do their hay, that it is worth for stock, half as much...Straw is worth for manure much more than a chemical analysis shows, for it is to most farmers the cheapest and most convenient absorbent they can use, and without it on many farms most of the liquid and soluble parts of the animal manure would be lost.

Seed corn should be carefully selected in early autumn and placed where it will be thoroughly dried before hard frost. Freezing does not injure well matured and well dried corn...It should be stored in a dry, airy place...Another plan highly rec-

ommended is to hang the corn in the smoke house and allow it to be thoroughly smoked with the meat. Not only is this a good and sure way of keeping it, but it is said the grain becomes so thoroughly impregnated with the smoke that insects will trouble neither the grain nor the young plant.

It is often a question of how much and how long corn should be cultivated. I am confident that increased cultivation gives an increased yield, and as an extra bushel per acre will about pay for an extra plowing, I think it will pay to cultivate oftener and longer than is usually done...Mr. Bonham, a corn-grower of great experience and success says he plows his corn until the pollen chokes him, and finds it pays.

I have found corn fodder the best bedding material for hogs confined in pens during winter. It keeps cleaner and lasts much longer than straw, and the hogs need some bulky food and they will eat the blades and part of the husks.

As to the removal of elements of fertility from the soil; instead of—as in the case of corn or wheat—having to charge the clover with $2.00 per acre on this score, we can actually give it a credit of $8.00 per acre for elements of fertility added to the soil...To prove that this is a reasonable estimate, it is sufficient to say that experience has abundantly demonstrated that a crop of clover will restore to the soil as much fertility as is taken away by four years cropping with grain...It would take at *least* barnyard manure to the value of $8.00 to do this.

It is not prudent to turn hungry cattle into a clover field the first time in the spring when the dew is on in the morning. I have talked with many farmers on this subject and find that I can never hear of a case of bloat when the pasture contains a strip of blue grass or timothy...Another preventive many farmers consider infallible, is to have a straw stack in the field to which the cows can have access.

If a few choice sound pumpkins be laid on a shelf in a dry cellar, safe from frost, and each be turned over each day, they can in many cases be kept for many months. The rotting of the pumpkin is caused by the water in the flesh settling to one side.

It was the practice in New England half a century ago, to plow the turnip land in the spring, fold the sheep on it all summer, and then merely loosen the surface with a harrow sufficient to enable the seed to be covered. This secured the packing of the land by the trampling of the sheep, its fertilization by their droppings, and also protection from the turnip flea, as the oil from the wool destroys them.

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